Course Syllabus: MAT 310 – Mathematical Statistics

Spring Semester 2013

Instructor: Ulrich Hoensch, Ph.D.

- E-mail: `hoenschu@rocky.edu`
- Office: Morledge/Kimball 118
- Office Phone: (406)-657-1126
- Office Hours: Monday, Wednesday 9:00 a.m. - 10:00 a.m. and 2:00 p.m. - 3:00 p.m; Tuesday, Thursday 9:00 a.m. - 10:00 a.m; Friday 9:00 a.m. - 10:00 a.m.; and other times by appointment.

Class Information

- Credits: 3 semester hours
- Class Meetings: Monday, Wednesday, Friday 8:00 a.m. - 8:50 a.m.
- Room: Bair 102
- Class Web Page: `www.rocky.edu/~hoenschu/SS_2013/MAT310/main.html`

Text Larsen/Marx, *An Introduction to Mathematical Statistics and Its Applications*, 5th Edition, Prentice Hall 2012 (required); **an advanced statistical calculator such as the TI-83 Plus is required** (ask instructor when in doubt).

Course Description A calculus-based introduction to statistical methods and theory. The course covers basic probability rules; random variables and probability distributions; limit theorems; sampling distributions; point and interval estimation methods; hypothesis testing, including t-and chi-square tests; the simple linear regression model and analysis of variance. Prerequisite: A grade of "C" or higher in MAT 275.

Rationale MAT 310 is a required course for the mathematics education major and a highly recommended course for a major and a minor in mathematics. Students who have completed MAT 275 should take MAT 310 instead of non-calculus based MAT 210. Students intending to enter graduate school, or a comparable professional program, in the areas of mathematics, engineering, chemistry and physics are strongly advised to complete this course.

Course Objectives At the completion of MAT 310, students will be able to:

(1) Formulate probability models and compute probabilities in a variety of settings.

(2) Compute expected values and distributions of random variables, and of combinations of random variables.

(3) Use methods for point and interval estimation.

(4) Perform hypothesis tests in a variety of settings.

(5) Use the simple linear regression model for prediction and estimation.

(6) Perform analysis of variance.

(7) Exhibit insight into the mathematical structures underlying the probabilistic and statistical techniques covered in this course.

Methods of Evaluation Students will be evaluated based on the following evidence.

- Exams and homework assignments.
- Attendance record, timeliness, the amount of courtesy and respect extended towards fellow students and the instructor.
- Level of academic and personal honesty and integrity.

Criteria for Grade Assignment To receive a passing grade, a student must show evidence that she/he is able to successfully perform the tasks laid out as course objectives (see above). Furthermore, students must attend all class meetings, arrive on time and exhibit appropriate classroom and social behavior. More specifically, a student is required to have accrued at least 60% of possible points to meet these criteria (see below). In addition, all submitted work must be the student's own work, or if it is not, names of sources or collaborators must be identified.

Possible points will come from:

- A midterm exam, and a final exam, each worth 200 points; here students must submit only their own work, by using only a statistical calculator, or other explicitly permitted material. Both the midterm and the final exam will have an in-class component (worth 100 points) and a take-home component (worth 100 points). **The take-home component of the exams must be turned in no later than the indicated due date.**
- Several homework assignments worth a total of 200 points.

This amounts to a total of 600 possible points. The following grading scale will be used to assign grades.

A: 90%, or more B: 80% - 89% C: 70%-79% D: 60%-69% F: less than 60% of possible points.

Instructional Methods and Experiences The format of this class is that of a small-class lecture. Student participation in the lecture is encouraged. Study groups outside of class are strongly recommended. However, completion of take-home exams must be done independently by each student.

Class Policies Students are required to attend all class meetings and complete all assignments. All homework assignments must be submitted at the beginning of class on the due date. All work on exams must be the student's own work, and may only be obtained through the use of explicitly allowed tools. Exams may only be made up if the instructor is notified as soon as possible of a qualified absence. Qualified absences are limited to the following: (a) activities connected with Rocky Mountain College programs; (b) grave illness (in which case a doctor's note is required); (c) a family or personal emergency, or due to force majeure. In cases (b) and (c) above, students may be excused from assignments if they notify the instructor immediately after their absence.

College Academic Policies Students must abide by all Academic Integrity Policies of the College. See `http://www.rocky.edu/index.php?type=academics&ct=policies` for details.

Date	Remarks/Topics
Mon Jan 07	**First Day of Class**; 2.3 The Probability Function
Wed Jan 09	2.4 Conditional Probability
Fri Jan 11	2.5 Independence
Mon Jan 14	2.6 Combinatorics
Wed Jan 16	2.6 Combinatorics
Fri Jan 18	2.7 Combinatorial Probability
Wed Jan 23	3.2 Binomial and Hypergeometric Probabilities
Fri Jan 25	3.3 Discrete Random Variables
Mon Jan 28	3.4 Continuous Random Variables
Wed Jan 30	3.5 Expected Values
Fri Feb 01	3.6 The Variance
Mon Feb 04	3.7 Joint Densities
Wed Feb 06	3.8 Transforming and Combining Random Variables
Fri Feb 08	3.9 Further Properties of the Mean and Variance
Mon Feb 11	3.10 Order Statistics
Wed Feb 13	3.11 Conditional Densities
Fri Feb 15	3.12 Moment-Generating Functions
Mon Feb 18	4.2 The Poisson Distribution
Wed Feb 20	4.3 The Normal Distribution
Fri Feb 22	4.3 The Normal Distribution
Mon Feb 25	4.4, 4.5, 4.6 Other Distributions
Wed Feb 27	**Midterm Exam**
Fri Mar 01	**Take-home Midterm Exam Due**; 5.2 The Method of Maximum Likelihood
Mon Mar 11	5.2 The Method of Moments
Wed Mar 13	5.3 Interval Estimation
Fri Mar 15	5.4 Properties of Estimators
Mon Mar 18	5.8 Bayesian Estimation
Wed Mar 20	6.2 The Decision Rule in Hypothesis Testing
Fri Mar 22	6.3 Testing Binomial Data, 6.4 Type I and Type II Errors
Mon Mar 25	6.5 The Generalized Likelihood Ratio
Wed Mar 27	7.2 The Student t-distribution
Wed Apr 03	7.3 The χ^2-distribution and the F-distribution
Fri Apr 05	7.4 Drawing Inferences about the Mean
Mon Apr 08	9.2 Testing for the Difference of Two Means
Wed Apr 10	9.4 Testing for the Difference of Two Proportions
Fri Apr 12	10.5 The χ^2-Test for Independence
Mon Apr 15	11.2 The Method of Least Squares
Wed Apr 17	11.3 The Linear Model
Fri Apr 19	11.4 Covariance and Correlation, 11.5 The Bivariate Normal Distribution
Mon Apr 22	12.2 The F Test and Analysis of Variance
Wed Apr 24	14.2 The Sign Test, 14.3 Wilcoxon Tests
Fri Apr 26	14.4 The Kruskal-Wallis Test, 14.5 The Friedman Test
Fri May 03	**Final Exam 7:45 a.m. - 9:45 a.m. in Bair 102**
Fri May 03	**Take-home Component of Final Exam Due at 12:00 noon**

OPI/PEPPS Standards

Standard	Course Objective
10.58.518 Mathematics	
(1) The program requires that successful candidates:	
(a) demonstrate knowledge and understanding of and apply the process of mathematical problem solving;	(1), (5)
(d) recognize, use, and make connections between and among mathematical ideas and in contexts outside mathematics to build mathematical understanding;	(1), (5), (7)
(e) use varied representations of mathematical ideas to support and deepen students' mathematical understanding;	(7)
(f) appropriately use current and emerging technologies as essential tools for teaching and learning mathematics;	(4), (5), (6)
(3) demonstrate content knowledge in:	
(e) discrete mathematics by applying the fundamental ideas of discrete mathematics in the formulation and solution of problems;	(1), (2), (4)
(f) data analysis, statistics, and probability by demonstrating an understanding of concepts and practices related to data analysis, statistics, and probability;	(1), (2), (3), (4), (5), (6), (7)